Paper ID: 64218
oral
student

IAF SPACE PROPULSION SYMPOSIUM (C4)
Electric Propulsion (2) (6)

Author: Mrs. Nina Sarah Mühlich
FOTEC Forschungs- und Technologietransfer GmbH, Austria

Mr. Emre Ceribas
FOTEC Forschungs- und Technologietransfer GmbH, Austria
Mr. Joachim Gerger
FOTEC Forschungs- und Technologietransfer GmbH, Austria
Mr. Bernhard Seifert
FOTEC Forschungs- und Technologietransfer GmbH, Austria
Prof. Friedrich Aumayr
TU Wien, Austria

HIGH-PRECISION DIGITAL FARADAY CUPS FOR FEEP THRUSTERS

Abstract

The number of scientific missions that require an extremely precise alignment of spacecraft achieved by electric thrusters has increased significantly in recent years. This requires a highly accurate knowledge of the thrust vector misalignment and the thrust intensity variation over time. In order to be able to resolve this high accuracy of the thruster beam, a high-precision plasma diagnostics system is required. For example, for upcoming missions like NGGM or LISA, it is required to get a spatial resolution of the ion beam current measurements $<0.5°$ in polar and azimuthal direction. In 2018 FOTEC developed a plasma diagnostics system to analyse low density ion beams, especially of FEEP thrusters like the IFM Nano Thruster. The diagnostics system consists of a remotely controlled semi-circular rotating arm equipped with 23 Faraday cups. These are used to measure the spatial ion current density distribution of the thruster beam. From the measurement data, the divergence angle and the thrust vector are computed. The Faraday cups measurement signal is first passed through cables outside the vacuum facility and processed there, which leads to a low signal-to-noise ratio. For noise reduction, the measurement was sampled 10 - 1000 times, depending on the thruster beam current. The measurement signal is also affected by secondary particle emission effects due to the Faraday cup geometry. Thereby secondary electrons are able to enter the Faraday cup and reduce the measured current. With the described system it would be impossible to analyse the thrust vector misalignment with high spatial resolution. For these reasons the plasma diagnostics system was optimised. On the one hand, the geometry was adapted to keep the reduction of the signal due to electron emission at a minimum. On the other hand, the entire measuring electronics were built into the head of each Faraday cup. This completely eliminates signal interference due to the cable length and movement of the diagnostics arm. Measurements of the digital Faraday cup diagnostics system will be presented, which were carried out at an IFM Nano Thruster. In particular, the signal-to-noise ratio could be significantly improved.